Chapter 2
PROCUREMENT AND PRODUCTION OF CONSTRUCTION MATERIALS

A supply of suitable construction material is the basis for establishing, maintaining, and repairing facilities in the Theater of Operations. Nearly all general engineering consumes raw and/or prefabricated construction materials. The most commonly needed materials are soil, sand, crushed rock, asphalt. concrete, and lumber. The burden of locating and manufacturing many of these materials fails mainly on Combat Heavy Engineer Battalions. However, all engineer units must be prepared to exploit available construction materials. Engineer units tasked to procure construction materials must make full use of their imagination, initiative, and resources. Where standard materials are not available, engineers must improvise.

Required construction materials may he supplied through military logistical systems, obtained from local manufacturers, extracted from local natural resources, or produced by engineer units. Planners must use the source or combination of sources that will fulfill the mission with maximum speed, efficiency, and economy.

SUPPLY THROUGH MILITARY LOGISTICAL SYSTEMS

The military logistical system is generally very responsive to the needs of the construction engineer units. This system has the advantage of being organized under nomenclature and units of measure familiar to supply personnel. This familiarity eases the movement of material through the supply chain. When material is in the military supply system, its quality can be more easily monitored, and supply status can be easily verified.

The disadvantages of the military supply system begin to appear further away from the source of supply. Long lead times must be considered by project planners if the normal supply system is used. The risk of damage to materials and the cost of materials to the government increase because of increased shipping and handling required.

PROCUREMENT FROM LOCAL MANUFACTURERS

Procurement of construction material from local manufacturers or producers alleviates many of the problems associated with military supply channels, but creates other concerns. Local procurement can greatly reduce the lead time before materials arrive at the construction site. In many cases the theater command arranges supply agreements with host nations before engineer units arrive. The agreements specify the type and quality of certain materials and specify the locations of material yards. Transportation arrangements, made with the host nation for moving materials closer to the constructing units, reduce the motor transport requirement of these units,

Local procurement of construction materials can cause problems because of variances in quality and dimensions. For example, some plywoods produced in European countries are of such high quality that the circular saw blades normally used in engineer units quickly dull, creating a slowdown in construction productivity. Some material may not meet dimensional standards required by the project. This may cause delays and require design modifications. Some materials, such as cement, may have slightly different chemical properties, which can alter the behavior of the material during construction. It is therefore important that using units become familiar with the locally procured material as soon as practical in order that any needed adaptations can be made.

ENGINEER-PRODUCED NATURAL RESOURCES

Natural resources can be tapped by engineer units as a source for soil, sand, gravel, and timber. Civilian and military intelligence sources, such as the Terrain Analysts and the Military Geographic Information (MGI) data base of the supporting topographic unit, can locate resources quickly. Since this information can significantly influence the location of some facilities and installations, it is important to identify resources quickly.

BORROW PITS

Borrow pits are the preferred source of construction aggregate and fill material when resources are scarce and material quality is not critical. Borrow pit material—gravel, sand, and fines—seldom needs to be blasted, crushed, or screened. Though its quality may not be as good as crushed stone, it is often acceptable. The equipment needed to work a borrow pit includes dozers for clearing and

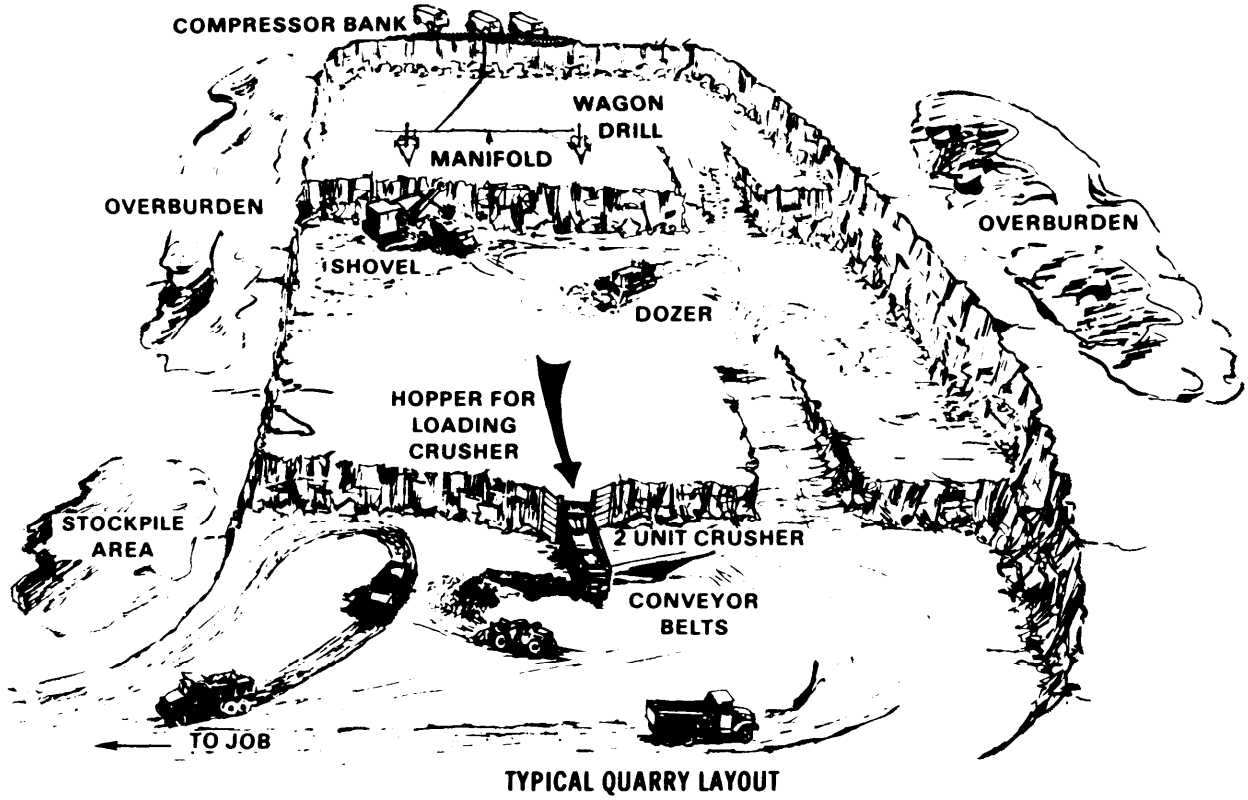
grubbing, dump trucks for hauling, and either scoop loaders, scrapers, or cranes with shovel or dragline attachments for loading.

Borrow pits are best located at the tops of hills close to or on the construction site for ease of material handling. If borrow pits are located away from the construction site, coordination with the local landowner must be effected, and additional care must be taken when closing down the pit to prevent undue damage to the surrounding terrain.

QUARRIES

A quarry is an open excavation from which rock may be removed, either by blasting or by ripping with bulldozers. Quarries are typically used when borrow pits cannot support the mission, either because the material is insufficient, the quality is poor, or because borrow pits are too far from the work site. Existing quarries should be used whenever possible, since developing and operating a quarry requires considerable time, manpower, and equipment. When planners consider opening a new quarry site, they must weigh the tactical situation, the security of the quarry unit, and the lead time required to develop the site. Engineer units with quarrying equipment are scarce resources in the active Army. The use of such units must be carefully planned.

The decision to develop a quarry site must also take into account the quality and quantity of material offered, the availability of trained personnel and equipment, the proposed quarry's rock structure and drainage, and the site's location with respect to civilian populace, access roads, facilities, utilities, and the construction site. The environmental impact of the quarrying operation should be considered because of possible air, ground water, and noise pollution. The equipment



TYPICAL QUARRY LAYOUT

needed to operate a quarry includes bulldozers, air compressors, crawler drills or hand drills, and either scooploaders or cranes with shovel attachments.

LOGGING OPERATIONS

When host nation support is not adequate to supply timber products for construction, planners may decide to conduct independent logging and/or sawmill operations. Logging is the process of converting standing timber into sawn logs or timber products and delivering them to the sawmill for the manufacture of lumber or heavy timber. Logs can be processed and used for such purposes as timber piles, bridge or wharf stringers, railroad ties, and framing members for protective structures. Logs can be processed into dimensioned lumber for use in Theater of Operations construction if drying time is available.

The Army's capability to conduct logging and sawmill operations is located solely in Engineer Forestry Teams in the Reserve establishment. The Forestry Team General of the Army (GA) is organized under Tables of Organization and Equipment (TOE) 5-520G. The team is divided into a team headquarters, a logging section, and a sawmill section. Such teams may be attached to a supply and service battalion of the general support group or to an engineer construction group, or it may be used to support independent operations. The Forestry Team is 75 percent mobile. Forestry Teams are scarce resources, and their use must be carefully planned.

When the decision has been made to use military resources to produce timber products, the first step in planning is to select a timber stand and sawmill site. Again, the supporting engineer topographic unit can provide useful information. The timber stand may be some distance away from the site of the sawmill. The planner must therefore plan for roads and bridges that can handle heavy loads. Supporting engineer units will need to provide for road maintenance. The sawmill site should be convenient to roads or railroads for transshipment of the lumber products. The sawmill must have a large, clear area around it, be well drained, and be located at a distance from inhabited areas. Provisions must be made for properly disposing of wood waste products and unused wood preservative, which can be hazardous to human beings. An adequate water supply must be available for fire protection at the sawmill.

The Forestry Team conducts a reconnaissance, called a timber cruise, to select a logging site. During the timber cruise, appropriate tree species are identified, and the timber stand's yield is estimated. After the timber cruise is completed, the selected trees are cut, then logs are cut to the correct length. These logs are loaded on trucks and taken to the sawmill, where bark is removed, the logs are sawn into the needed dimensions, and wood preservative is applied. The dimensional stability and sturdiness of the wood is enhanced if it is dried in a kiln or in the open air. The drying process consumes valuable space and time.

ENGINEER-PROCESSED MATERIALS

CRUSHED ROCK PRODUCTION

Rock of specific size and gradation is needed for asphalt and concrete production. Crushed rock is used as the base course for roads and airfields. Rock from quarry operations and some borrow pit material must be crushed, screened, and perhaps washed to meet quality standards for construction missions. It is almost a certainty that a supply of crushed rock will be needed in any Theater of Operations construction.

Certain Army engineer units in the active and reserve component have the equipment and trained personnel to establish and op erate large-scale rock crushing plants. Rock processing units, like quarry units, are low-density engineer resources which must be used carefully. Planners must be aware that moving a rock processing unit and establishing operations at a new site requires considerable lead time.

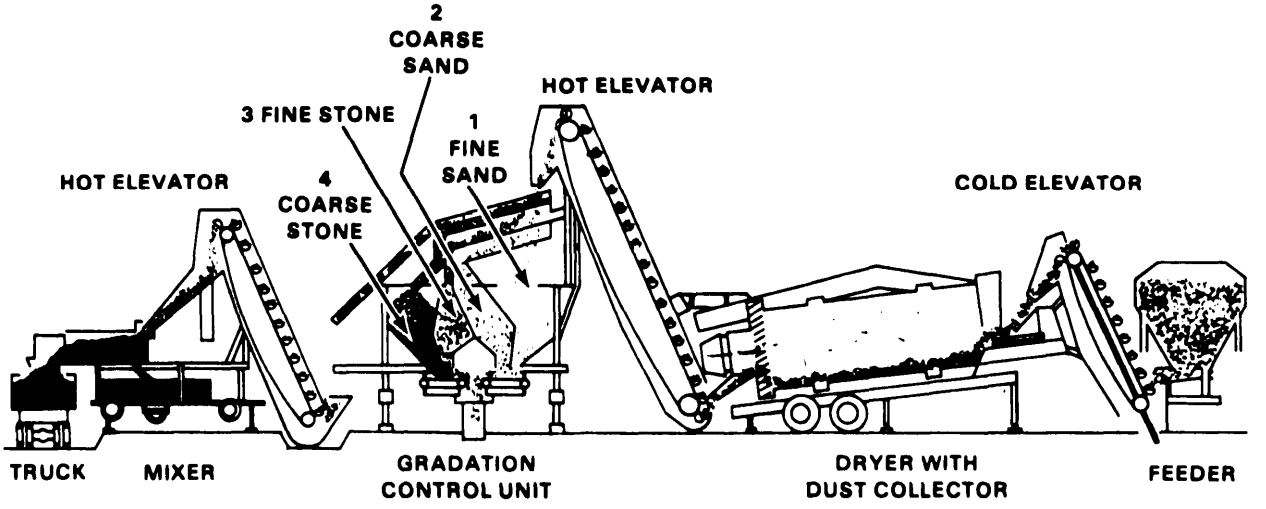
The plant must be sited within a reasonable distance of the quarry and the construction project. It should be located on level ground with good drainage. Adequate space should be available for equipment, stockpiles, maintenance areas, related facilities and utilities, and for expansion. An adequate supply of water must be available for the washing process.

The two most common rock processing units have either a 75- or a 225-ton per hour rock processing plant. Each plant consists of several large pieces of towed equipment, The major components are crushers, screening equipment, washing equipment, and portable conveyers. Planners must be aware that the actual output of any given plant differs from its nominal capacity. Actual production reflects the plant's capacity to handle the specific product input, the desired size of the final product, the size of the crushing equipment, and the proportion of by-product or waste produced.

Other problems that are inherently part of rock processing operations must be considered. Equipment maintenance is inevitably a major task, because the heavy loads and abrasive action of crushing and moving tons of rock rapidly wears and damages equipment. Repairs are sometimes difficult, because spare parts are often scarce.

ASPHALT PRODUCTION

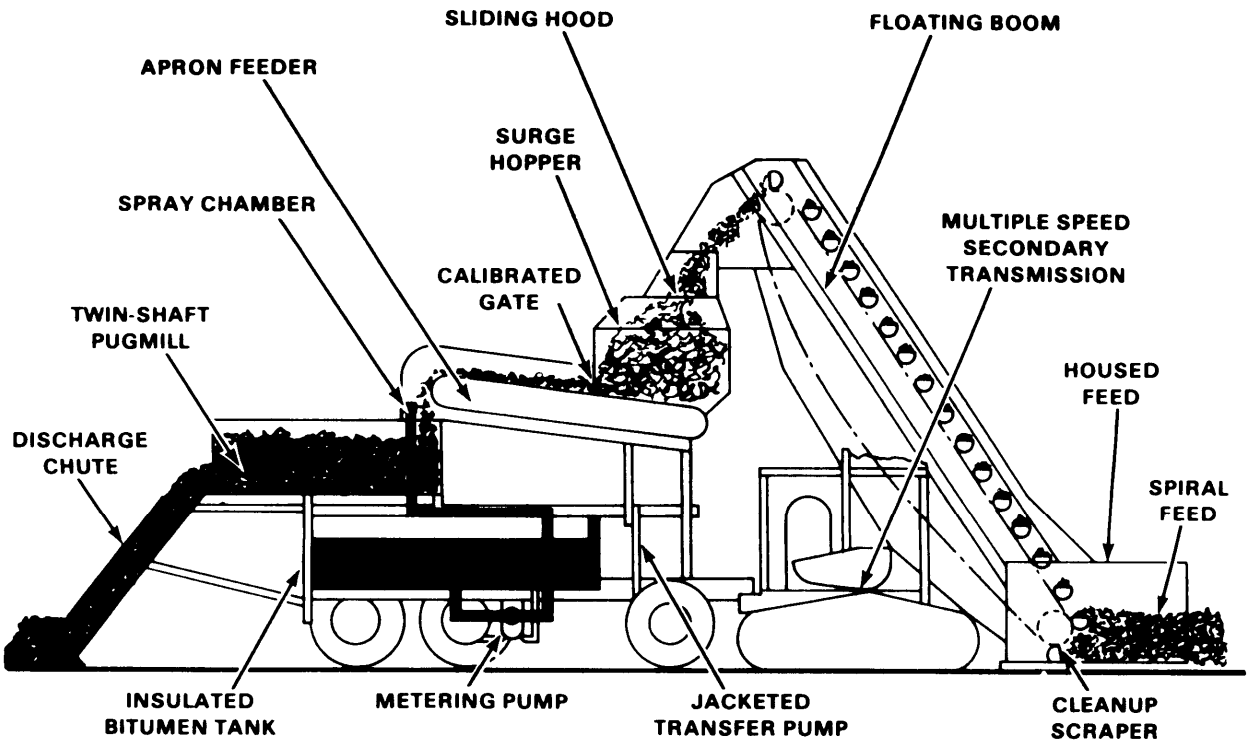
Engineer units with organic asphalt plants are low density engineer resources in both the active and reserve components, and should be used carefully. Moving and establishing an asphalt plant requires considerable lead time. An adequate source of raw materials, such as rock, sand, and bitumen, must be available.



ASPHALT PLANT WITH TRAILER-MOUNTED ELEMENTS
Barber-Greene Co., Bituminous Construction Handbook
(Aurora, IL, Barber-Greene, 1963), Figure 67.

The 100- to 150-ton per hour asphalt plant is the Army's current plant. This plant can produce all types of bituminous mixes, including high-type concrete, cold mixes, and stabilized base mixtures. The plant consists of a mixer, hot elevator, gradation control unit, dryer, and feeder, all of which are trailer mounted. The upper half of the gradation control unit, the cold elevator, and numerous ancillary parts must be moved on extra trailers. Equipment needed to support plant operations includes dump trucks, portable conveyors, scoop loaders, bulldozers, and cranes with clamshell attachments. An air compressor with drum cutting tools is needed to open drums of asphalt cement, and fuel trucks are needed to supply the hot oil heaters and power plants.

When it is determined that a military asphalt plant is needed, planners must select an optimal site. A large, well-drained area with a gravel or hard top surface is to be preferred. The plant must be close to both the source of aggregate and the construction site, because most bituminous mixes either become too cool or begin to cure if they are not placed quickly. A good road net is needed to avoid traffic jams and resultant cooling of mixes. The planner must also consider the potential environmental problems, including dust generated by the plant and potential soil pollution from bitumen and fuel spills.



STANDARD ASPHALT TRAVEL PLANT
Barber-Greene, Bituminous Construction Handbook, Figure 75.

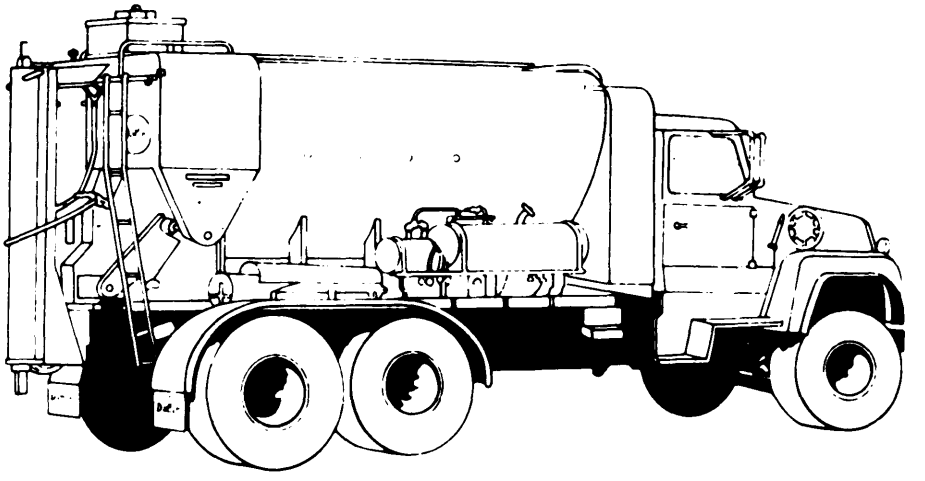
PORTLAND CEMENT CONCRETE PRODUCTION

Portland cement concrete can be produced, on a small to medium scale, by any Army engineer battalion and by most of the special engineer support companies in the active component. Certain engineer units in the Army Reserve and National Guard establishment have the organic equipment and trained personnel to install and operate central mix concrete plants if the project calls for large amounts of portland cement concrete.

The production of any portland cement requires that the proper raw materials be available. The concrete requires gravel or crushed rock as the coarse aggregate, and sand as the fine aggregate. These materials must be available in sufficient quantities. The coarse aggregate must be of the proper gradation and of a specific size, depending on the structure that is to be built. The fine aggregate should be well graded and free of deleterious material. There must be source of fresh and preferably potable water available at the mixing site. Water is also required at the construction site for use in curing the fresh concrete. Finally, portland cement must be provided to the using unit either through the military supply chain or through local procurement in the host nation.

Small and medium scale concrete requirements can be satisfied by any Army engineer unit with either the 16S concrete mixer or the M919 Concrete Mobile. The 16S mixer can be easily moved to remote locations; it supplies small scale concrete requirements. It is manpower-intensive in operation. Several of the 16S mixers can be grouped together to construct an efficient concrete central mix plant.

The M919 Concrete Mobile is a self contained concrete material transporter and mixing machine. This machine is capable of producing high quality, fresh concrete at the construction site. It is a one-person operation, as the driver of the vehicle is also the operator of the mixer. This machine has the capacity to carry materials for 8 cubic yards of concrete when it is fully loaded. The machine's maneuverability is limited to good roads and firm ground at the construction site. Scoop loaders are generally required to support the M919 at the materials yard.



M919 CONCRETE MOBILE

Large scale concrete requirements can be satisfied by those reserve engineer units which operate central mix plants. Central mix plants have the facilities to handle, store, batch, and mix concrete materials. The individual materials are accurately proportioned, then mixed in a large drum mixer. The concrete is deposited in dump trucks and moved to the job site. Central mix plants are capable of producing 80 cubic yards of fresh concrete per hour. This type of production may be desirable on a large project such as an airfield. Central mix plant operations require the support of scoop loaders, cranes with clamshell attachments, and dump trucks. Central mix plants must be located near the construction site and near a supply of raw materials and water. They must also be situated on firm ground with good drainage, and have plenty of area for vehicular maneuver.